(19) JAPANESE PATENT OFFICE

PATENT ABSTRACTS OF JAPAN

(11) Publication number: 06266480 A

(43) Date of publication of application: 22.09.94

(51) Int. Cl G06F 1/32
G06F 1/04

(21) Application number: 05055521

(22) Date of filing: 16.03.93

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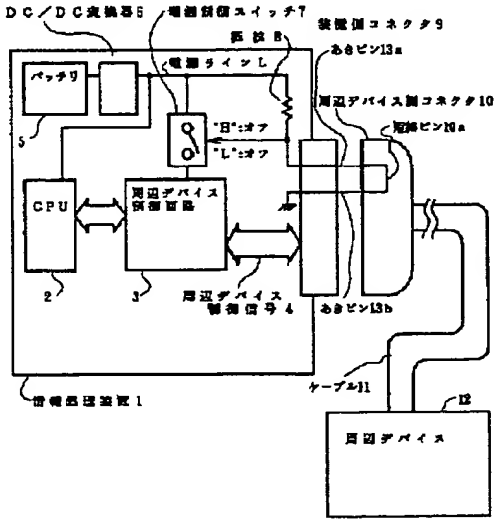
(54) **POWER SUPPLY CONTROL METHOD**

(57) Abstract:

PURPOSE: To provide the power control method which reduces the power consumption of an electronic apparatus to which a peripheral device is connected through a peripheral device control circuit and a connector.

CONSTITUTION: It is detected whether a connector 10 of a peripheral device 12 is connected to a connector 9 of an information processor 1 or not; and when it is not connected, power supply to a peripheral device control circuit 3 which controls the peripheral device 12 is stopped by a switch 7, thus preventing unnecessary power consumption.



Japanese Patent Application Laid-Open No. 6-266480

[Abstract]

[Object] A power supply control method is provided for reducing power consumed by an electronic apparatus to which a peripheral device is connected through a peripheral device control circuit and a connector.

[Configuration] It is detected whether or not a connector 10 of a peripheral device 12 is connected to a connector 9 of an information processing apparatus 1, and power supply to a peripheral device control circuit 3 for controlling the peripheral device 12 is shut down by a switch 7 when the connector 10 is not connected, thereby preventing unnecessary power consumption.

[Claims]

[Claim 1] A power supply control method for an electronic apparatus to which a peripheral device is connected through a peripheral device control circuit and a connector, characterized by shutting down or reducing power supplied to the peripheral device control circuit when the connector is not connected.

[Claim 2] The power supply control method according to claim 1, characterized by reducing the power supplied to the peripheral device control circuit when the connector is not connected by reducing the frequency of a clock for driving the peripheral device control circuit.

[Claim 3] A power supply control method for an electronic apparatus to which a peripheral device is connected through a peripheral device control circuit and a connector, the electronic apparatus being registered with a device driver for a used peripheral device to be used, the power supply control method characterized by shutting down or reducing power supplied to the peripheral device control circuit when the device driver associated therewith is not registered.

[0008]

[Embodiments] A power supply control method according to the present invention will hereinafter be explained in detail with reference to the accompanying drawings.

<First Embodiment> FIG. 1 is a diagram illustrating an information processing apparatus 1 or an electronic apparatus to which a power supply control method according to a first embodiment of the present invention is applied, and a peripheral device 12 or an optional device which is connected to the apparatus 1. The information processing apparatus 1 may be, for example, a portable notebook-sized personal computer, and the peripheral device 12 may be a floppy disk storage device or the like optionally connected to the notebook-sized personal computer. As illustrated, the information processing apparatus 1 according to this embodiment comprises a CPU 2 for performing information processing; a battery 5 for supplying power to the CPU 2 and other component circuits (not shown) or the like; a DC/DC converter 6 for DC/DC-converting the power

from the battery 5; a peripheral device control circuit 3 for controlling the peripheral device 12 connected in response to an instruction from the CPU 2 through a peripheral device control signal 4; an apparatus side connector 9 for transmitting and receiving the peripheral device control signal 4 and the like to/from the peripheral device 12; and a power supply control switch 7 for supplying the peripheral device control circuit 3 with the power from the DC/DC converter 6. When the optional peripheral device 12 is used, the connector 9 is connected to a connector 10 through a cable 11 of the peripheral device 12. The apparatus side connector 9 includes a free pin 13a applied with power supplied from a power supply line L through a pull-up resistor 8, and a grounded free pin 13b, while the peripheral device side connector 10 includes short-circuiting pins 10a for short-circuiting the pins 13a and 13b when it is connected to the apparatus side connector 9.

[0009] The power supply control switch 7 switches on or off power to the device control circuit 3 depending on power supplied from the connector 9. When the connectors 9 and 10 are not connected, a control terminal of the power supply control switch 7 is set to "H" to turn off the power supplied to the device control circuit 3. When the connectors 9 and 10 are connected, the control terminal of the switch 7 is set to "L" to turn on the power supplied to the control circuit 3. It should be noted that while the information processing apparatus 1 and the peripheral device 12 in this embodiment

contain other circuits and mechanisms, description thereon is omitted in this disclosure for facilitating the understanding of the present invention.

[0010] The information processing apparatus 1 configured in the foregoing manner may be extended by additionally installing the peripheral device 12 in accordance with a manner in which the processing apparatus 1 is used. Such additional installation is accomplished by the connectors 9 and 13. First, description will be made on a power control which is employed when the information processing apparatus 1 performs processing alone. In this case, the apparatus 1 is powered such that the power from the battery 5 and converted by the DC/DC converter 6 is supplied to the CPU 2 and only other circuits, not shown, which are required when the apparatus 1 is used alone. Also, in this case, since the free pin 13a of the apparatus side connector 9 is open, the control terminal of the power supply control switch 7 is set to "H," thereby blocking the power supplied to the device control circuit 3 through the switch 7. On the other hand, when the information processing apparatus 1 is connected to the peripheral device 12 through the respective connectors 9 and 10, the apparatus 1 is powered such that the power from the battery 5 is supplied to the CPU 2 and the other circuits (not shown), required when the apparatus 1 is used alone, in a manner similar to the above. Additionally, in this case, since the free pin 13a of the connector 9 is conducted to the pin 13b through the short-circuit pins 10a of the connector 10 and therefore grounded,

the control terminal of the power supply control switch 7 is set to "L," thereby allowing the device control circuit 3 to be powered through the switch 7.

[0011] As described above, the power supply control method according to this embodiment switches on/off the power supply control switch for powering the peripheral device control circuit 3 in the apparatus 1 depending on whether the connector 9 of the information processing apparatus 1 is connected to the peripheral device side connector 10, thereby making it possible to block unnecessary power supplied to the peripheral device control circuit 3, when the peripheral device 12 is not connected, to accomplish power saving for the apparatus. While this embodiment has been explained for an example in which a connected peripheral device is detected by the electric conduction through the short-circuit pins in the peripheral device side connector, the method of detecting a connected peripheral device according to the present invention is not limited to the above, and other embodiments, later described, may also be employed for the detection.

[0012] <Second Embodiment> FIG. 2 is a diagram illustrating an example for detecting the above-mentioned connection of a connector using a microswitch built in a connector of the information processing apparatus. The microswitch of the power control circuit comprises a button 14 which has a protrusive leading end extending from a button presser plate 16, which is fitted into the peripheral device side connector 10, such that the leading end is pressed when

the peripheral device side connector 10 is fitted; a button rail 17 for guiding movements of the button 14; and contact plates 15a, 15b which are brought into and out of contact with each other by movements of a rear end of the button 14 caused by connection and disconnection of the peripheral device side connector 10. The contact plate 15b is grounded, while the contact plate 15ab is connected to the free pin 13a and the control terminal of the power supply control switch 7, in a manner similar to the aforementioned embodiment. The battery and the remaining circuit configuration of the information processing apparatus are similar to those of the aforementioned embodiment. The connector of the peripheral device has a normal connector shape. Although not shown, the button 14 is urged by a spring or the like toward the presser plate 16.

[0013] The power supply control method according to this embodiment for the information processing apparatus configured as described above detects a connection with a connector 100 of a peripheral device by the microswitch built in the connector 91 of the information processing apparatus. Like the first embodiment, when the information processing apparatus 1 performs processing alone, the rear end of the button 14 forming part of the microswitch is at a position at which it does not press the contact plates 15a and 15b with a spring or the like, so that the control terminal of the power supply control switch 7 is set to "H," causing the switch 7 to block the power supplied therethrough to the device control circuit 3. When the connector 91 of the information processing apparatus is

connected to the connector 100 of the peripheral device, the connected connector 100 presses the button 14 to bring the contact plates 15a and 15b into contact to ground the pin 13b. This in turn sets the control terminal of the power supply control switch 7 to "L," thereby allowing the switch 7 to supply the power to the device control circuit 3 therethrough.

[0014] As described above, the power supply control method according to this embodiment detects a connection of the connector 91 to the connector 100 using the microswitch built in the connector 91 of the information processing apparatus to switch on/of the power supply control switch for supplying the power to the peripheral device control circuit 3 in the apparatus 1, thereby making it possible to accomplish power saving for the apparatus by blocking the power supplied to the peripheral device control circuit 3 when the peripheral device 12 is not connected, without adding any modification to the connector 100 of the peripheral device. It should be noted that the microswitch in this embodiment is not limited to the structure illustrated in FIG. 2, but any other structure may also be employed as long as it is not obstructive to the insertion of a connector. In addition, the microswitch is not limited to the connector built-in type.

[0015] <Third Embodiment> FIG. 3 is a diagram illustrating an example which includes a power supply control switch 71 for connecting a power supply line L and a peripheral device control circuit 3 which is powered from the battery within the information processing apparatus in each of the

foregoing embodiments. This embodiment is characterized by the power supply control switch 71 which can be switched on/off arbitrarily by an operator external to the housing of the apparatus 1. The power supply control method of this embodiment can save the power consumed by the information processing apparatus in such a manner that the operator switches off the power supply control switch 71 when determining that no peripheral device is used, and switches on the power supply control switch 71 when a peripheral device is used. Particularly, a power supply according to this embodiment can stop powering the peripheral device control circuit 3 by the switch 71, for example, even with a peripheral device connected to the information processing apparatus, while the operator does not use the peripheral device, thereby accomplishing more power saving for the device. For example, assuming that the information processing apparatus is a portable notebook-sized personal computer and the peripheral device is a modem for communications, the switch 71 may be switched off while a mail to be transmitted is being created in a communication preparation stage to accomplish power saving.

[0016] <Fourth Embodiment> FIG. 4 is a diagram for explaining a power supply control method according to a yet further embodiment. The power supply control method according to this embodiment accomplishes the power saving by reducing the frequency of a clock for driving the device control circuit using the connector switch or the like shown in the

aforementioned embodiments, rather than stopping the power supplied to the device control circuit itself by the switch depending on a connection state of a connector as is the case of the respective embodiments described above. Specifically explaining, a device control circuit 31 applied to this embodiment comprises a clock divider 18 for dividing an input operating clock; and a selector 19 for receiving the input operating clock and a clock at a lower frequency divided by the divider 18 as inputs to selectively output these clocks to a control circuit 20 depending on a clock selecting signal 21, later described, as illustrated in FIG. 4. For the clock selecting signal 21, the signal for detecting a connection state of a peripheral device, explained in the first to third embodiments, is used. It should be noted that the circuits and mechanisms of the information processing apparatus and the peripheral device in this embodiment are similar to those of the foregoing embodiments except for the power supply control switch 7 or 71.

[0017] The power supply control method according to this embodiment relies on the clock selecting signal 21 indicative of a connection state of the peripheral device side connector 10 with the connector 9 of the information processing apparatus 1 or an instruction of the operator to switch a driving clock selected by the selector 19 within the peripheral device control circuit 31 in the apparatus 1. The control circuit 21, that is, the device control circuit 31 is driven by the clock at lower frequency, divided by the clock divider 18, when no

peripheral device is connected, and driven by the normal operating clock when a peripheral device is connected, thereby making it possible to accomplish the power saving for the apparatus. Particularly, in this embodiment, since the power supplied to the peripheral device control circuit 31 is not stopped, the power supply control method has an effect that a connection state or the like of a peripheral device previously accessed by the peripheral device control circuit 31 is not erased.

[0018] <Fifth Embodiment> FIGS. 5 and 6 are diagrams for explaining a power supply control method according to a yet further embodiment of the present invention. Unlike the respective embodiments explained above, this embodiment controls the powering for the peripheral device control circuit 3 using software and a power control register for storing a power consumption mode corresponding to a situation such as whether a peripheral device is connected or not. First, an information processing apparatus 101 according to this embodiment comprises, as illustrated, a CPU 2 for processing information; a battery 5 for powering the CPU 2 and other component circuits (not shown); a DC/DC converter 6 for DC/DC-converting power from the battery 5; a peripheral device control circuit 3 for controlling a peripheral device 12 connected in response to an instruction from the CPU 2 through a peripheral device control signal 4; an apparatus side connector 93 for transmitting and receiving the peripheral device control signal 4 and the like to/from the peripheral

device 12; a power control register 22 for setting a power consumption mode for each peripheral device control circuit 3 in response to an instruction from the CPU 2; and a memory 200 for storing a number of programs for performing an operation control and the like for the information processing apparatus 101. When the optional peripheral device 12 is in use, the apparatus side connector 93 is connected to a peripheral device side connector 102 through a cable 11 of the peripheral device 12. Also, in this embodiment, while only one pair of the peripheral control circuit and the corresponding connector is shown, an actual information processing apparatus, for example, a personal computer contains a plurality of peripheral device control circuits and corresponding connectors in accordance with a plurality of additionally installed devices such as an external storage device, a printer and the like.

[0019] Similarly to a normal personal computer, the memory 200 stores an OS used when starting the apparatus; a system configuration file (CONFIG. SYS) for configuring the system by instructing settings for the number of files, the number of sector buffers and the like upon starting, and also by instructing settings for a device driver in accordance with a peripheral device to be used; a batch file for starting software; and a variety of application software. Specifically describing, the system configuration file (CONFIG.SYS) is registered with device drivers for a printer and for a mouse; a print system; and a mouse system in addition to the specification of the number of files and the number of buffers,

as shown in Table 1 below. The batch file for starting software is registered, for example, with an interface system (RS232C) for specifying a communication interface necessary when an application software is communication software.

[0020]

[Table 1]

CONFIG. SYS	NUMBER OF FILES = 10 NUMBER OF BUFFERS = 10 DRIVER = PRINT SYSTEM DRIVER = MOUSE SYSTEM
COMMUNICATION SOFTWARE SETTING. BAT	DRIVER = INTERFACE SYSTEM

[0021] The power control register 22 in turn stores a table for specifying a lower power consumption mode and a normal power consumption mode for the peripheral device control circuit 3 for each of a plurality of devices in response to an instruction from the CPU 2. For example, the power control register 22 stores a mode specifying table for indicating a reduction in the number of driving clocks in the fourth embodiment.

[0022] Next, the power supply control method in the information processing apparatus 101 configured as described above will be explained with reference to a flowchart illustrated in FIG. 6. First, as the information processing apparatus 101 is powered on (step 61), the information processing apparatus 101 reads the OS from the memory 200 to start the apparatus, resets peripheral devices connected thereto (step 62), and instructs the power control register 22 to set the lower power consumption mode to all peripheral

device control circuits 3 (step 63). Next, the apparatus reads the system configuration file from the memory, and sets the device drivers, for example, the device drivers for a printer and a mouse (step 64). Next, the apparatus searches peripheral devices corresponding to the registered device drivers (step 65), sets the normal mode to the power mode of the power control register 22 for the peripheral devices 12 which have associated device drivers registered in the system configuration file (step 66), and maintains the lower power consumption mode in the power control register 22 for peripheral devices 12 which have no associated device drivers registered in the system configuration file (step 67). Then, the apparatus 1 performs other initial settings with the batch file for starting software before required software is started.

[0023] In this way, the information processing apparatus 101 according to this embodiment references the device drivers which have been set upon starting the apparatus, and sets the peripheral device control circuits associated with peripheral devices corresponding to registered device drivers to the normal power consumption mode, and the peripheral device control circuits associated with peripheral devices corresponding to unregistered device drivers to the low power consumption mode, thereby making it possible to reduce the power consumption. In recent years, devices have become more susceptible to failure by little static electricity due to the tendency of lower voltage, higher speed operation and smaller size. The present invention can also protect such devices and

circuits when they are not in use to improve the reliability. Further, by reducing the power consumption of the entire apparatus, the apparatus can operate for a longer period of time with the battery.

[0024] While the foregoing embodiment has been explained for an example in which the device drivers are referenced only when the apparatus is started to set the power consumption mode, the present invention is not limited to this. Alternatively, the device drivers and the like set in the internal memory may be referenced when used software is switched to switch the power consumption mode. Also, the low power consumption mode is not limited to reducing the power but may comprise stopping the power supply as is the case of the first embodiment. Further, the electronic apparatus directed by the present invention is not limited to the aforementioned notebook-sized personal computer and a portable game machine. It goes without saying that the present invention can be applied to other electronic apparatus including DAT or the like which can be connected, for example, with a microphone, an amplifier or the like as an external option, AV devices, measuring instruments, radios, and the like.

[0025]

[Effects of the Invention] As described above, the power supply control method according to the present invention monitors a connecting state of a connector for a peripheral device to reduce or stop the power supplied to and consumed by the peripheral device control circuit, thereby making it

possible to prevent power consumed by the peripheral device control circuit not in use, to reduce power consumption also in an analog electric load circuit and an electronic apparatus for which a load driving state cannot be sensed by means of a circuit, and to reduce power consumption of the entire apparatus by reducing the frequency of the clock for driving the peripheral device control circuit associated with a connector to which no peripheral device is connected. Further, the power supply control method according to the present invention, for use in an electronic apparatus registered with device drivers for used peripheral devices, stops or reduces the power supplied to the peripheral device control circuit associated with a peripheral device for which the device driver has not been registered, thereby making it possible to reduce the power consumption of the entire apparatus by monitoring connecting states of peripheral devices in software.

[Brief Description of the Drawings]

[FIG. 1] A diagram for explaining a power supply control method which electrically detects a connected connector in accordance with an embodiment of the present invention.

[FIG. 2] A diagram for explaining a power supply control method which detects a connected connector with a microswitch in accordance with an embodiment of the present invention.

[FIG. 3] A diagram for explaining a power supply control method which specifies a connection of a connector using a switch in accordance with an embodiment of the present invention.

[FIG. 4] A diagram for explaining a method of reducing power to a peripheral device control circuit in accordance with the present invention.

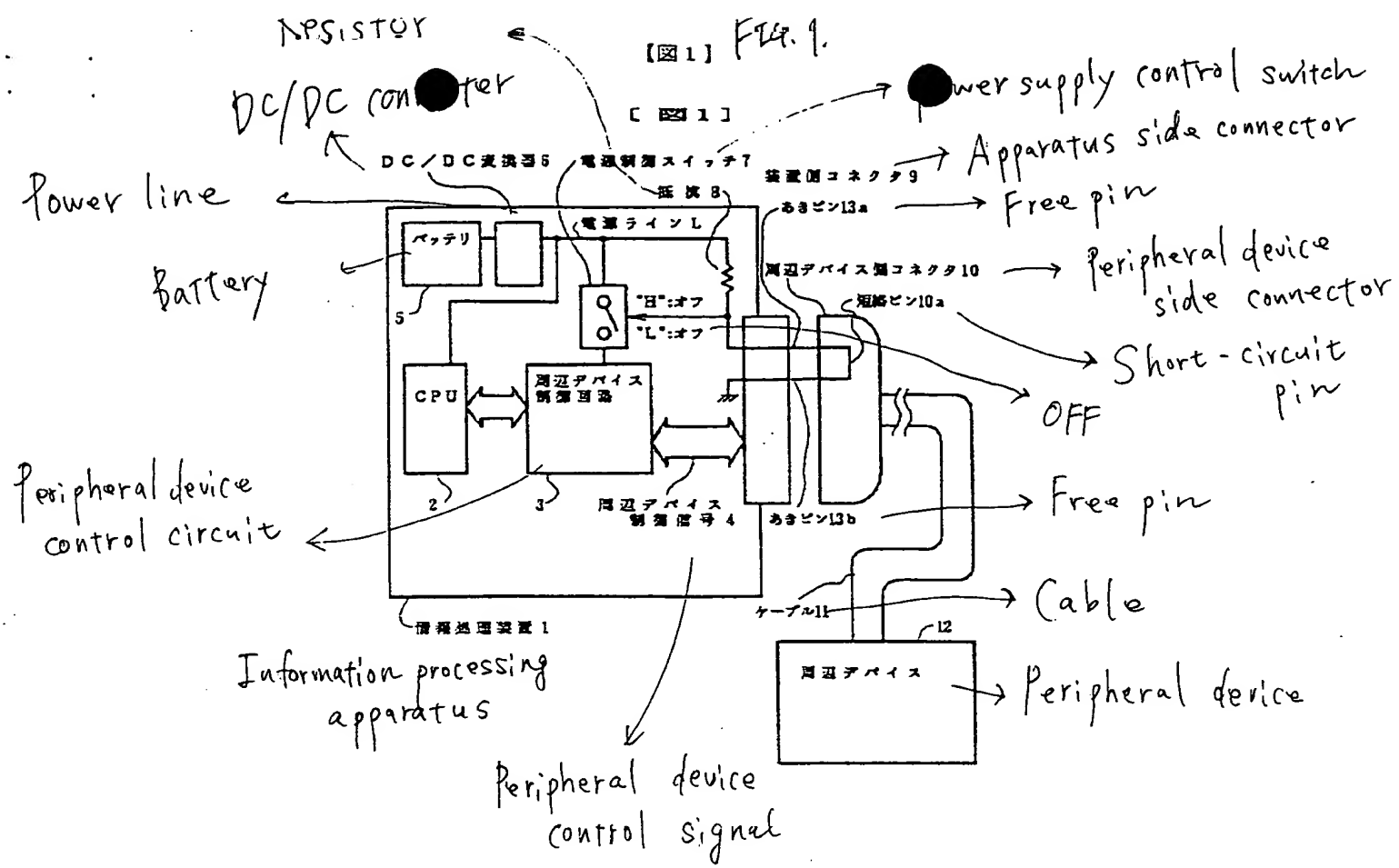
[FIG. 5] A diagram for explaining a power supply control method which detects in software whether a peripheral device is in use in accordance with an embodiment of the present invention.

[FIG. 6] A flowchart for explaining the operation of an apparatus illustrated in FIG. 5.

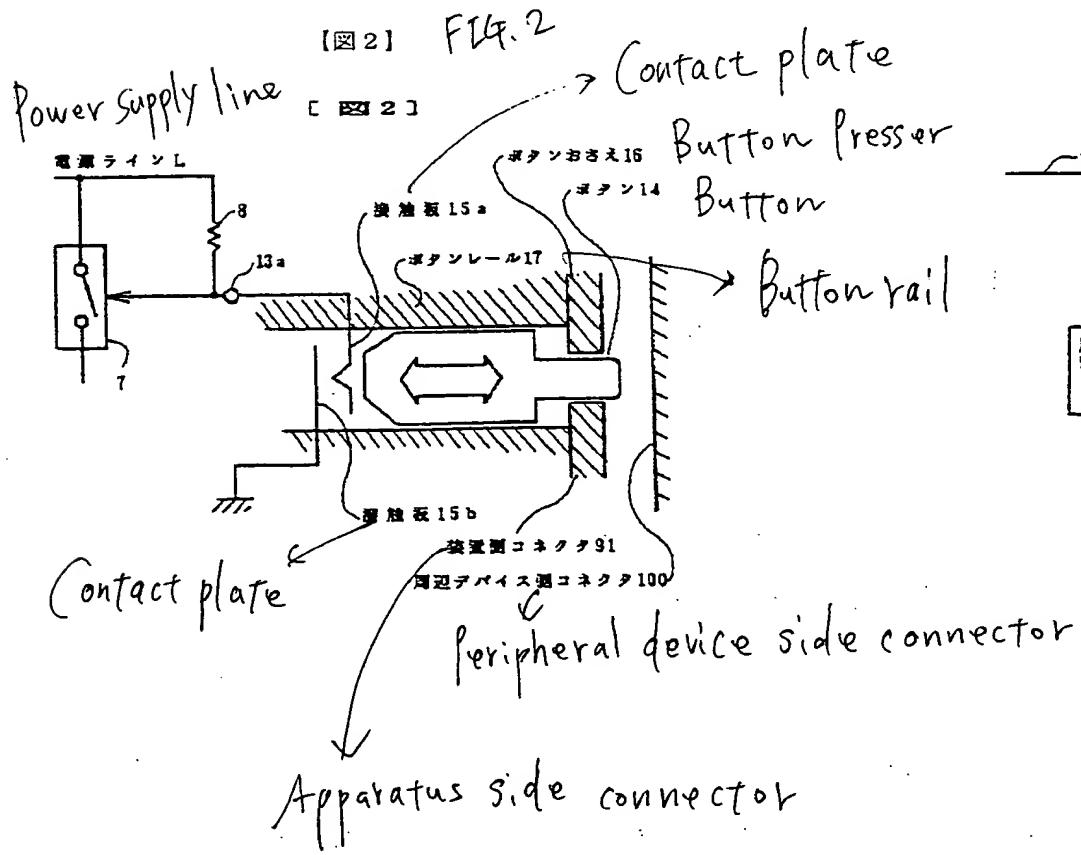
[Explanation of Reference Numerals]

1 ... Information Processing Apparatus, 2 ... CPU, 3 ... Peripheral Device Control Circuit, 4 ... Peripheral Device Control Signal, 5 ... Battery, 6 ... DC/DC Converter, 7 ... Power Supply Control Switch, 8 ... Resistor, 9 ... Apparatus Side Connector, 10 ... Peripheral Device Side Connector, 11 ... Cable, 12 ... Peripheral Device, 13a ... Free Pin, 13b ... Free Pin, 14 ... Button, 15a ... Contact Plate, 15b ... Contact Plate, 16 ... Button Presser, 17 ... Button Rail, 18 ... Clock Divider, 19 ... Selector, 20 ... Control Circuit, 21 ... Clock Selecting Signal, 22 ... Power Control Register, 200 ... Memory.

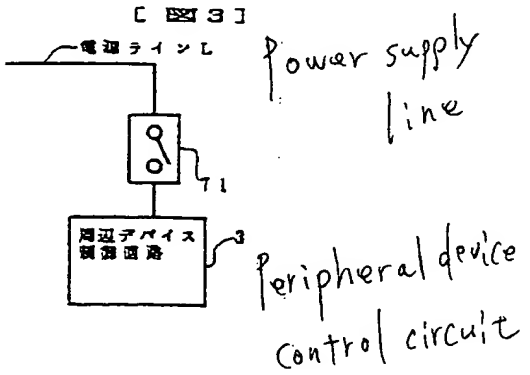
【図1】 FIG. 1.



【図2】 FIG. 2



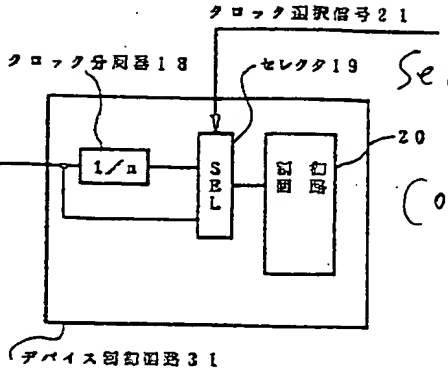
【図3】 FIG. 3



【図４】 FIG. 4

Clock divider

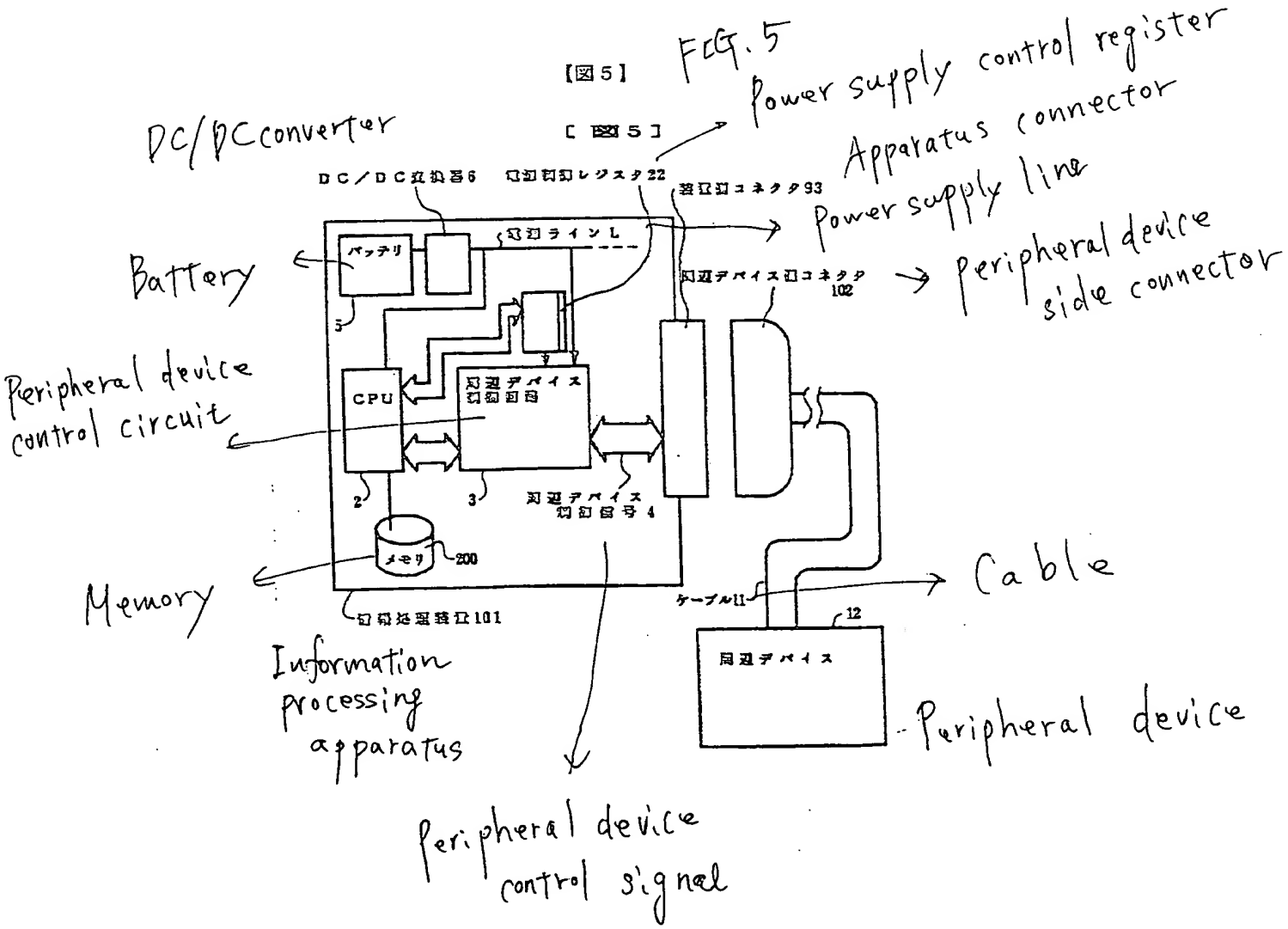
［図４］ Clock selecting signal



Device control circuit

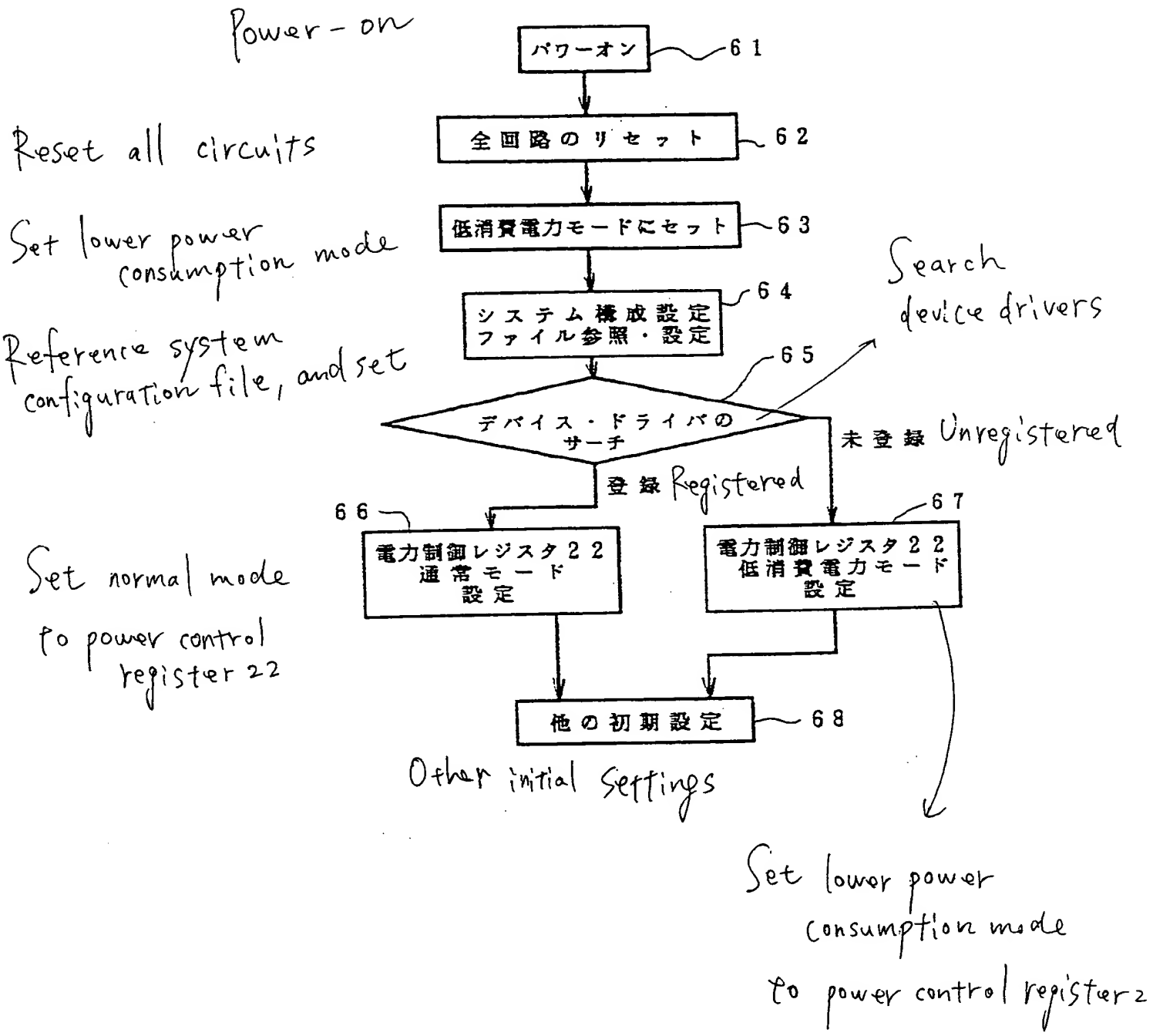
【図５】 FIG. 5

［図５］



【図6】

[図6]


Power-on
パワーオン
61
Reset all circuits
全回路のリセット
62
Set lower power consumption mode
低消費電力モードにセット
63
Reference system configuration file, and set
システム構成設定ファイル参照・設定
64
Search device drivers
65
デバイス・ドライバのサーチ
未登録 Unregistered
登録 Registered
66
電力制御レジスタ22 通常モード設定
67
電力制御レジスタ22 低消費電力モード設定
Set normal mode to power control register 22
他の初期設定
68
Other initial Settings
Set lower power consumption mode to power control register 2